ATTACHMENT 7
ROG Emissions
Livestock Wastes
San Joaquin Valley

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Farming Operations

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
620-618-0262-0000 (66605) Livestock Wastes

METHOD FOR CALCULATING EMISSIONS

The ROG emissions in this source category come from the wastes generated by different livestock animals. According to the "U.S. EPA 1980 Volatile Organic Compounds (VOC) Species Data Manual, Second Edition", ROG accounts for eight percent of the total organic gases (TOG) emitted from livestock waste. Our ROG emission calculation was therefore based on the estimates of TOG emissions and the speciation profile. The baseline TOG emissions were estimated as the sum of eight livestock subcategories, which are: 1) beef cattle, 2) dairy cattle, 3) hogs and pigs, 4) sheep and lambs, 5) turkeys, 6) chicken fryers and broilers, 7) chicken layers, and 8) other livestock. For each subcategory, the emissions were calculated by multiplying the animal population over the year with the emission factor. A factor to account for residency time was applied to adjust population, since some animals have a residency time of less than one year.

The population data come from two sources. For beef cattle and dairy cattle, their populations were developed using the data published by California Department of Food and Agriculture (CDFA) in 1997. The populations for all non-cattle categories were grown from the data that the SJVUAPCD staff reported in their 1995 methodology document of livestock wastes emissions. The adjustment factor for residency time and the TOG emission factors were from the SJVUAPCD 1995 methodology document as well.

Livestock		Emission Factor (lb/head/year)	Reference
Beef Cattle		160	1938, Ritzman
Dairy Cattle		160	1938, Ritzman
Hogs and Pigs		58	1978, KVB
Sheep and Lambs		12	1938, Ritzman
Turkeys		2.4	1978, KVB
Chicken	Fryers and Broilers	2.4	1978, KVB
	Layers	2.4	1978, KVB
Other		2.4	1978, KVB

The TOG emission factors were tracked back to two major studies. The emission factors for cattle and sheep were originally published in a 1938 study of "Nutritional Physiology of the Ruminant". Later studies have not provided better emission factors for use in California. The other emission factors were first published in a 1978 KVB report, "Control of Hydrocarbon Emissions from Stationary Sources in the California South Coast Air Basin", but further tracking of their references were unsuccessful.

ROG EMISSIONS IN THE SAN JOAQUIN VALLEY

Summer ROG emissions are shown below. Summer ROG emissions are the same as the annual average emissions due to insufficient knowledge of temporal variation. The 1999 base year emissions were calculated by subcategory. Because the emissions were grown as a whole category to project for future years, the subcategory emissions are unavailable for year 2010.

Summer ROG Emissions (tons per day)

Year	Beef Cattle	Dairy Cattle	Hogs & Pigs	Sheep & Lambs	Turkeys	Chickens		Other	All Livestock
						Fryers & Broilers	Layers		
1999	8.9	36.6	1.3	0.2	2.4	6.7	12.4	0.0	68.6
2010									86.9

GROWTH AND CONTROL ASSUMPTIONS

The growth trend for livestock waste is the emission weighted composite of dairy growth and non-dairy growth. The district and ARB have reached consensus on the growth assumptions, and we are not using the assigned Pechan growth surrogate for this category. Non-dairy livestock are assumed to have zero growth. Dairy growth was constructed by three periods due to the rapid growth of dairy industry during 1986 to 2000 in the SJV. The growth of dairy cattle was delimited into three periods: pre-1986, 1986 to 2000, and post-2000. Human population growth was used to develop dairy cattle growth trend for the pre-1986 and post-2000 periods. For the years 1986 to 2000, the growth was based on the historical trend developed from CDFA data.

There are no control assumptions applied to this category.

Growth Factors

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Livestock Wastes	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3

TEMPORAL ACTIVITY

The temporal activity is assumed to occur seven days a week and 24 hours a day. Due to insufficient information of temporal variation for this category, it is assumed that air emissions occur evenly throughout the year.

Hours	Days	Weeks
24	7	52

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3

FUTURE IMPROVEMENTS

ARB is proposing to split the category of livestock wastes into nine separate categories. A new methodology for calculating livestock wastes emissions is planned to be released at the end of this year. The nine categories are range cattle, dairy cattle, feedlot cattle, poultry, swine, sheep, goat, horse, and other livestock. In addition, ARB has a multi-year contract with California State University Fresno (CSUF) to measure the ROG emissions from dairies. CSUF is conducting the field tests, and the later laboratory results will be used to improve the ROG emission factor and the speciation profile. The SJV Dairy Subgroup is overseeing this work, and it is coordinated with similar research being performed by the University of California Davis.